

# **NATIONAL BUREAU OF STANDARDS REPORT**

7063

on

Interlaboratory Intercomparisons

of

40-Watt T12 Daylight Fluorescent Lamps

by

Velma I. Burns  
Photometry and Colorimetry Section  
Metrology Division



**U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS**

## THE NATIONAL BUREAU OF STANDARDS

### Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. Research projects are also performed for other government agencies when the work relates to and supplements the basic program of the Bureau or when the Bureau's unique competence is required. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

### Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers. These papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three periodicals available from the Government Printing Office: The Journal of Research, published in four separate sections, presents complete scientific and technical papers; the Technical News Bulletin presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: Monographs, Applied Mathematics Series, Handbooks, Miscellaneous Publications, and Technical Notes.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards (\$1.25) and its Supplement (\$1.50), available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

# NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT

NBS REPORT

0201-20-02113

January 1961

7063

## Interlaboratory Intercomparisons of 40-Watt T12 Daylight Fluorescent Lamps

by  
Velma I. Burns  
Photometry and Colorimetry Section  
Metrology Division

### IMPORTANT NOTICE

NATIONAL BUREAU OF STAN  
Intended for use within the Go  
to additional evaluation and rev  
listing of this Report, either in  
the Office of the Director, Natic  
however, by the Government ag  
to reproduce additional copies

Approved for public release by the  
director of the National Institute of  
Standards and Technology (NIST)  
on October 9, 2015

gress accounting documents  
lly published it is subjected  
roduction, or open-literature.  
is obtained in writing from  
ch permission is not needed,  
pared if that agency wishes



U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS



Interlaboratory Intercomparisons  
of  
40-Watt T12 Daylight Fluorescent Lamps

Abstract

A group of eight 40-watt, T12, daylight fluorescent lamps was measured in each of eight laboratories. The line voltage was held constant at 236.0 volts across the lamps in series with a reactor having 439 ohms impedance and 7 to 8% power factors. The luminous flux, current, lamp volts, lamp watts, and the x and y chromaticity coordinates were measured. The results of the measurements made by the individual laboratories and an analysis of the results are given in this report.

I. Introduction

This intercomparison was undertaken to determine the uniformity of measurements on 40-watt, T12, daylight fluorescent lamps made at the participating laboratories. The laboratories participating and the order of reading are as follows:

1. Duro Test
2. Electrical Testing Laboratories
3. Westinghouse
4. General Electric
5. Interlectric
6. Sylvania
7. Champion
8. National Bureau of Standards

Each laboratory followed its own customary procedure in making the measurements. Measurements at each laboratory were obtained while holding the line voltage constant at 236.0 volts across the lamps in series with a reactor having 439 ohms impedance and 7 to 8% power factor. The power supply was connected to the marked pins.

This group started at Duro Test with twelve lamps. Four lamps were broken at various times during the intercomparisons. The values for only the eight remaining lamps are reported herein.

II. Results of Measurements

The results reported are given in tables 1 through 7. The averages reported for each lamp and for each laboratory are given. The differences between the average for each laboratory and the average of all laboratories for all the lamps are also given in the tables.

III. Analysis of the Results

An analysis of the results of the measurements has been made following a modification of the method described by W. J. Youden (1), (2), and (3). The



modified method is described in National Bureau of Standards Report No. 6605 "Interlaboratory Intercomparisons of 32-watt T10 Cool-White Circline Lamps" and No. 6698 "Interlaboratory Intercomparisons of 40-watt T12 Cool-White Fluorescent Lamps". The analysis is shown on the following graphs. The point representing the measurements by an individual laboratory is designated by the first letter in the name of the laboratory. The point representing the average of all laboratories is designated by the letter A.

- (1) Graphical Diagnosis of Interlaboratory Test Results; Industrial Quality Control Vol. XV, No. 11, May 1959.
- (2) Product Specification and Test Procedures; Industrial and Engineering Chemistry, Vol. 50, page 914, October 1958.
- (3) Circumstances Alter the Cases; Industrial and Engineering Chemistry, Vol. 50, page 77A, December 1958.

Table 1

Lumens

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave.
2	2273	2290	2231	2339	2270	2314	2280	2302	2287.4
3	2285	2245	2232	2339	2262	2330	2296	2300	2286.1
4	2300	2325	2264	2358	2265	2362	2282	2306	2307.8
6	2284	2250	2226	2331	2230	2314	2268	2287	2273.8
7	2290	2330	2235	2345	2253	2334	2268	2278	2291.6
8	2295	2285	2247	2359	2260	2332	2296	2288	2295.2
10	2304	2335	2235	2349	2272	2298	2276	2285	2294.2
12	2300	2335	2263	2367	2288	2324	2290	2297	2308.0
Ave.	2291.4	2299.4	2241.6	2348.4	2262.5	2326.0	2282.0	2292.9	2293.0
Δ	-1.6	+6.4	-51.4	+55.4	-30.5	+33.0	-11.0	-.1	
% Δ	-.07%	+.28%	-2.24%	+2.42%	-1.33%	+1.44%	-.48%	-.00%	



Table 2

Amperes

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave.
2	.429	.423	.430	.428	.430	.431	.431	.431	.4291
3	.428	.423	.429	.428	.430	.429	.431	.428	.4282
4	.430	.426	.430	.430	.430	.431	.431	.430	.4298
6	.427	.425	.430	.430	.430	.430	.433	.430	.4294
7	.430	.422	.430	.429	.430	.432	.433	.428	.4292
8	.430	.425	.430	.429	.430	.430	.435	.430	.4299
10	.429	.424	.429	.431	.430	.430	.432	.429	.4292
12	.429	.423	.430	.429	.430	.431	.431	.427	.4288
Ave.	.4290	.4239	.4298	.4292	.4300	.4305	.4321	.4291	.4292
△	-.0002	-.0053	+.0006	.0000	+.0008	+.0013	+.0029	-.0001	
%△	-.05%	-1.23%	+.14%	.00%	+.19%	+.30%	+.68%	-.02%	

Table 3

Lamp Volts

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave.
2	102.5	103.0	102.7	102.7	101.5	101.8	102.0	101	102.15
3	103.0	103.0	103.6	103.0	103.5	103.0	104.0	103	103.26
4	102.2	102.0	102.8	103.0	102.5	101.5	104.7	102	102.59
6	102.5	102.0	102.5	102.7	103.0	102.3	102.8	103	102.60
7	102.5	104.0	103.2	103.2	103.5	100.8	103.0	104	103.02
8	101.6	102.5	102.6	102.7	103.5	102.5	102.0	103	102.55
10	100.8	102.5	103.2	101.9	102.5	101.5	103.1	102	102.19
12	102.2	103.0	103.6	102.7	103.0	102.5	104.0	104	103.12
Ave.	102.16	102.75	103.02	102.74	102.88	101.99	103.20	102.75	102.69
△	-.53	+.06	+.33	+.05	+.19	-.70	+.51	+.06	
%△	-.52%	+.06%	+.32%	+.05%	+.19%	-.68%	+.50%	+.06%	



Table 4

Lamp Watts

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave
2	39.8	40.1	40.1	40.4	41.0	40.1	39.9	39.8	40.15
3	40.0	40.1	40.3	40.4	41.0	40.7	40.6	40.5	40.45
4	39.9	39.9	40.1	40.6	41.5	40.2	41.0	40.5	40.46
6	40.3	39.7	40.1	40.6	42.0	40.5	40.3	40.5	40.50
7	40.1	40.2	40.3	40.8	41.5	39.8	40.4	40.8	40.49
8	39.8	40.1	40.2	40.6	42.0	40.6	40.2	40.6	40.51
10	39.8	40.0	40.2	40.1	42.0	40.3	40.4	40.2	40.38
12	<u>40.0</u>	<u>40.1</u>	<u>40.4</u>	<u>40.3</u>	<u>41.0</u>	<u>40.6</u>	<u>40.6</u>	<u>40.6</u>	<u>40.45</u>
Ave.	39.96	40.02	40.21	40.48	41.50	40.35	40.42	40.44	40.42
△	-.46	-.40	-.21	+.06	+1.08	-.07	0	+.02	
%△	-1.14%	-.99%	-.52%	+.15%	+2.67%	-.17%	0	+.05%	

Table 5

Lumens per Watt

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave
2	57.1	57.1	55.6	57.9	55.4	57.7	57.2	57.8	56.98
3	57.1	56.0	55.4	57.9	55.2	57.2	56.7	56.8	56.54
4	57.7	58.3	56.5	58.1	54.6	58.8	55.6	56.9	57.06
6	56.7	56.7	55.5	57.4	53.1	57.1	56.3	56.5	56.16
7	57.1	58.0	55.5	57.5	54.3	58.6	56.2	55.8	56.62
8	57.7	57.0	55.9	58.1	53.8	57.4	57.3	56.4	56.70
10	57.9	58.4	55.6	58.6	54.1	57.0	56.4	56.8	56.85
12	<u>57.5</u>	<u>58.2</u>	<u>56.0</u>	<u>58.7</u>	<u>55.8</u>	<u>57.2</u>	<u>56.5</u>	<u>56.6</u>	<u>57.06</u>
Ave.	57.35	57.46	55.75	58.02	54.54	57.62	56.52	56.70	56.75
△	+.60	+.71	-1.00	+1.27	-2.21	+.87	-.23	-.05	
%△	+1.06%	+1.25%	-1.76%	+2.24%	-3.89%	+1.53%	-.41%	-.09%	



Table 6

x Coordinate

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave
2	.3182	.317	.320	.3187	.315	.319	.320	.319	.3184
3	.3177	.317	.319	.3190	.315	.318	.320	.319	.3181
4	.3183	.318	.319	.3206	.315	.319	.320	.319	.3186
6	.3182	.317	.319	.3194	.315	.319	.320	.319	.3183
7	.3178	.317	.319	.3197	.315	.318	.320	.319	.3182
8	.3178	.317	.319	.3197	.315	.318	.320	.319	.3182
10	.3174	.316	.319	.3198	.315	.318	.320	.318	.3179
12	<u>.3175</u>	<u>.317</u>	<u>.320</u>	<u>.3197</u>	<u>.315</u>	<u>.319</u>	<u>.321</u>	<u>.319</u>	<u>.3185</u>
Ave.	.3179	.3170	.3192	.3196	.3150	.3185	.3201	.3189	.3183
Δ	-.0004	-.0013	+.0009	+.0013	-.0033	+.0002	+.0018	+.0006	
% Δ	-.13%	-.41%	+.28%	+.41%	-.1.04%	+.06%	+.57%	+.19%	

Table 7

y Coordinate

Lamp No.	Duro Test	ETL	West	GE	Interl	Syl	Champ	NBS	Ave.
2	.3476	.344	.348	.3459	.338	.348	.347	.349	.3459
3	.3482	.344	.348	.3463	.339	.347	.348	.350	.3463
4	.3480	.345	.348	.3465	.338	.348	.348	.350	.3464
6	.3480	.344	.347	.3461	.338	.347	.346	.350	.3458
7	.3472	.344	.347	.3462	.338	.347	.346	.350	.3457
8	.3492	.345	.347	.3456	.339	.348	.348	.350	.3465
10	.3467	.344	.347	.3461	.338	.347	.348	.349	.3457
12	<u>.3478</u>	<u>.344</u>	<u>.347</u>	<u>.3467</u>	<u>.339</u>	<u>.348</u>	<u>.347</u>	<u>.350</u>	<u>.3462</u>
Ave.	.3478	.3442	.3474	.3462	.3384	.3475	.3472	.3498	.3461
Δ	+.0017	-.0019	+.0013	+.0001	-.0077	+.0014	+.0011	+.0037	
% Δ	+.49%	-.55%	+.38%	+.03%	-2.22%	+.40%	+.32%	+.1.07%	



Figure 1

Lumens

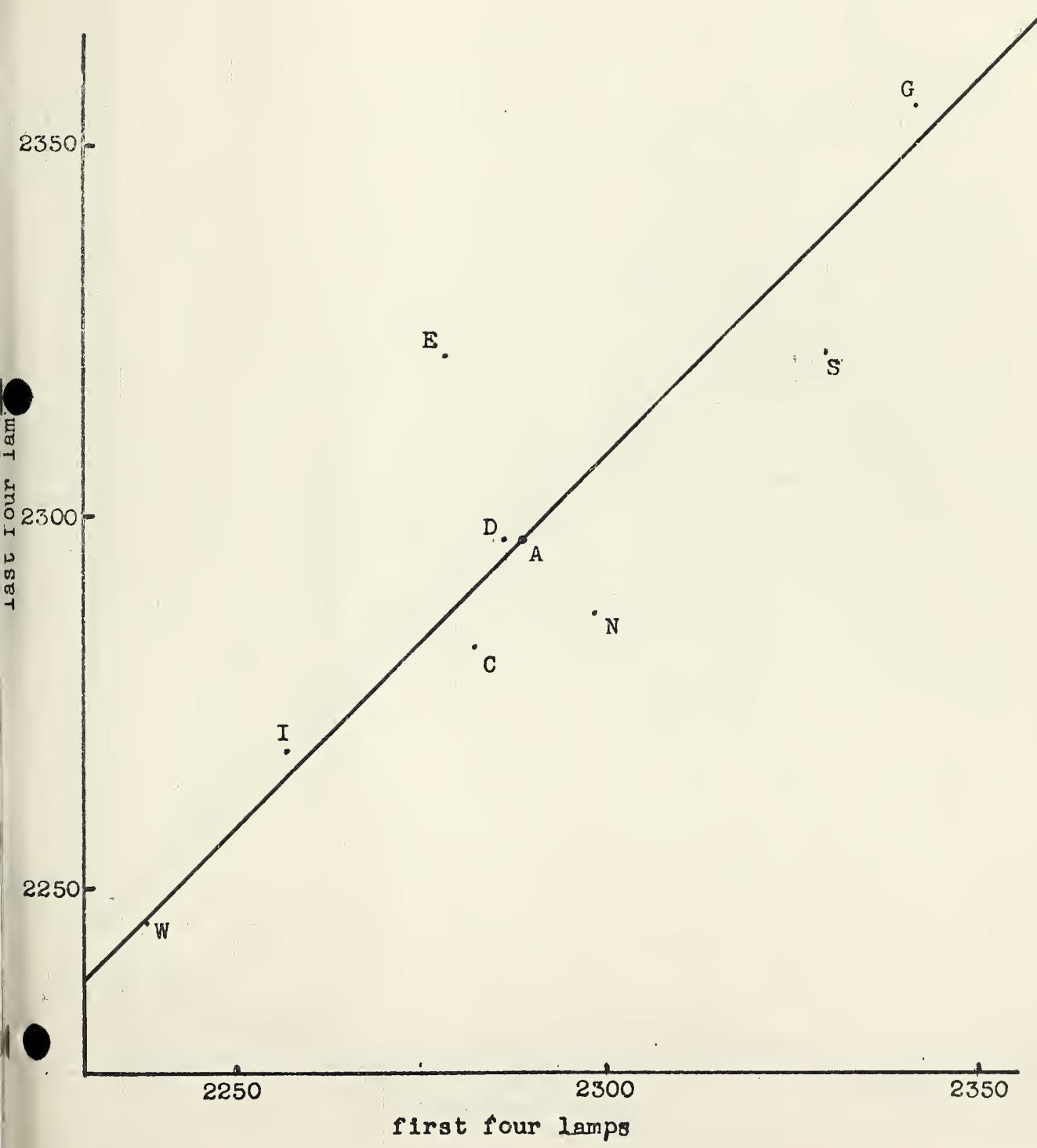




Figure 2

Amperes

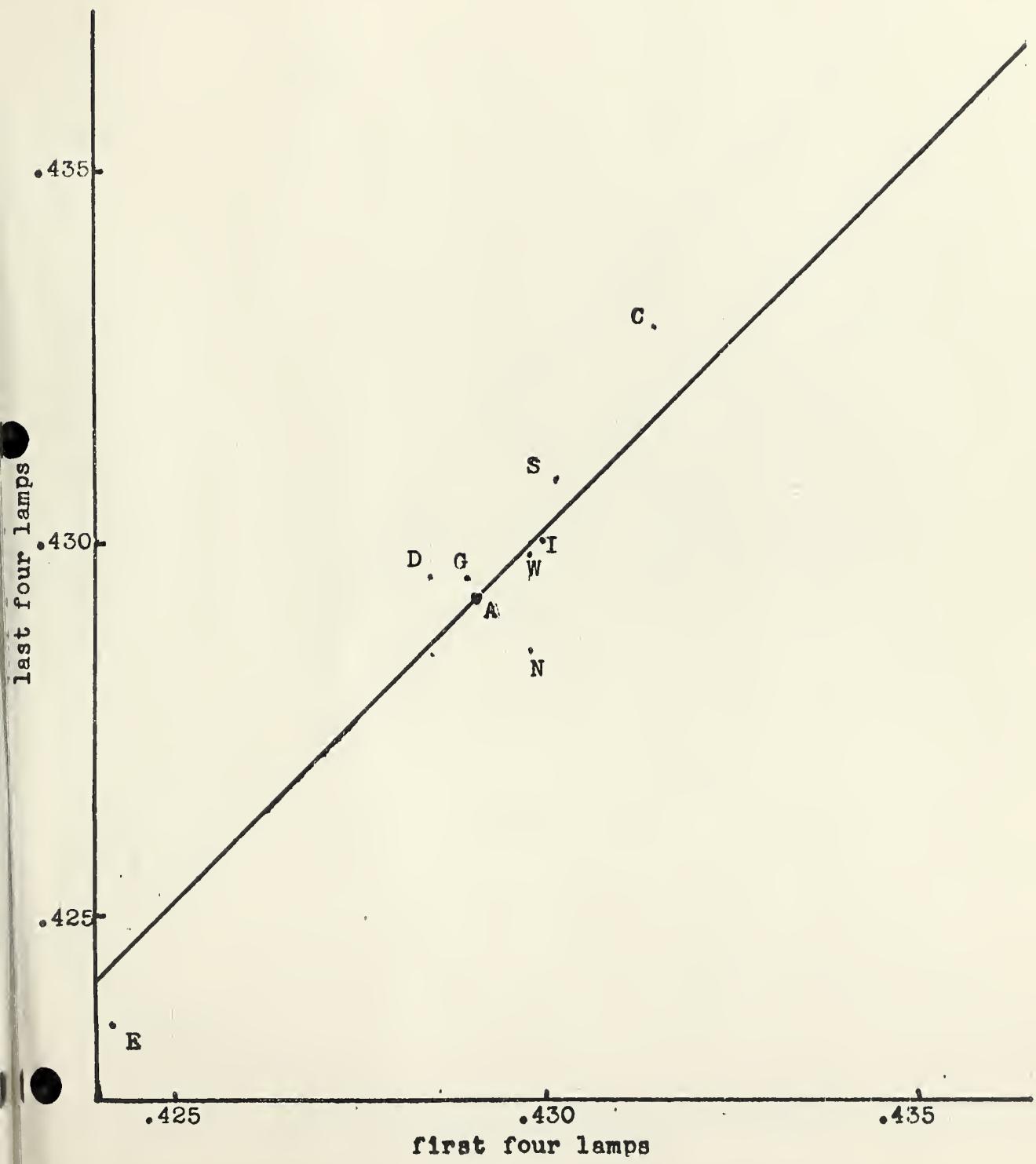




Figure 3

Lamp Volts

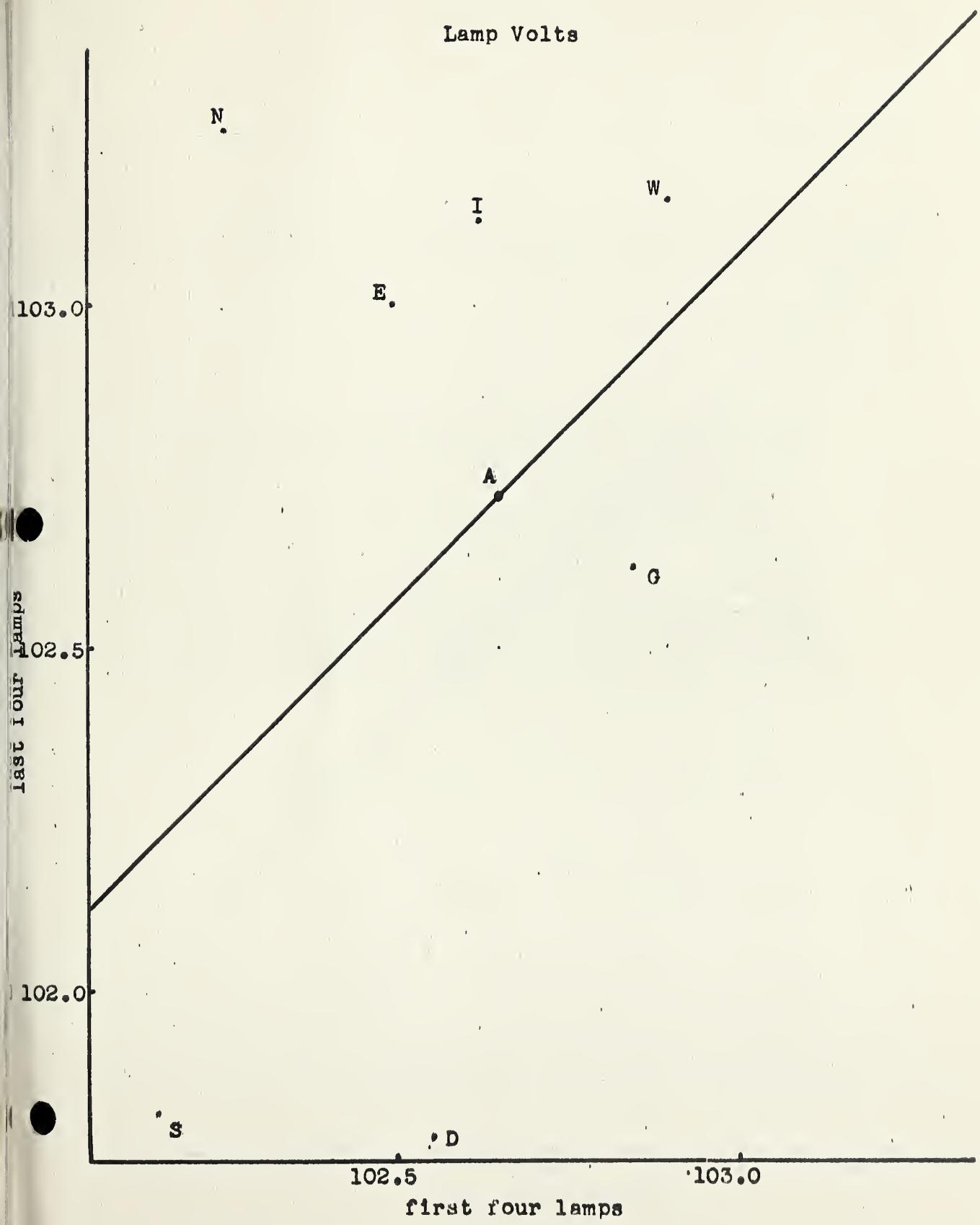




Figure 4  
Lamp Watts

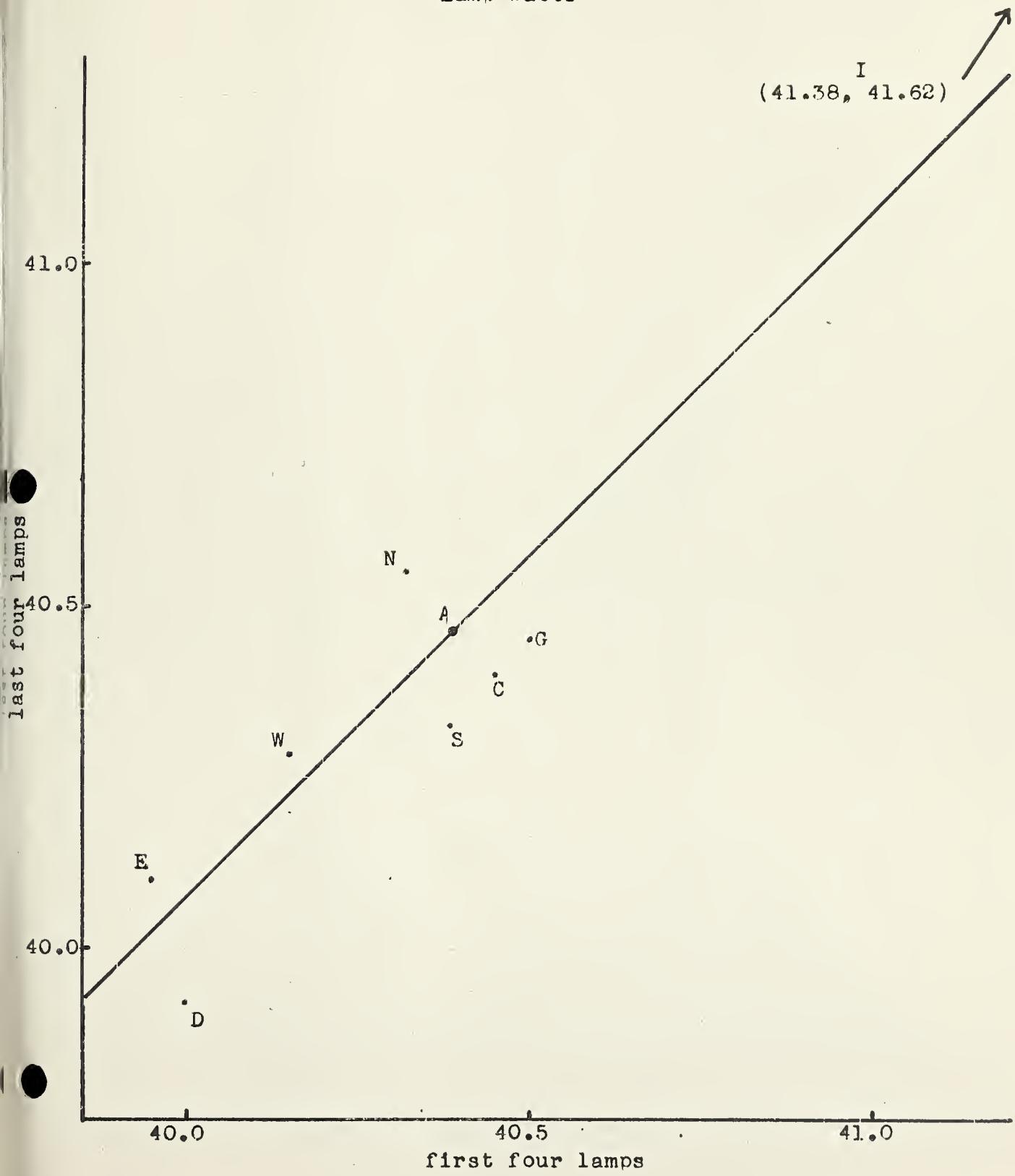




Figure 5

Lumens per Watt





Figure 6  
x Coordinate

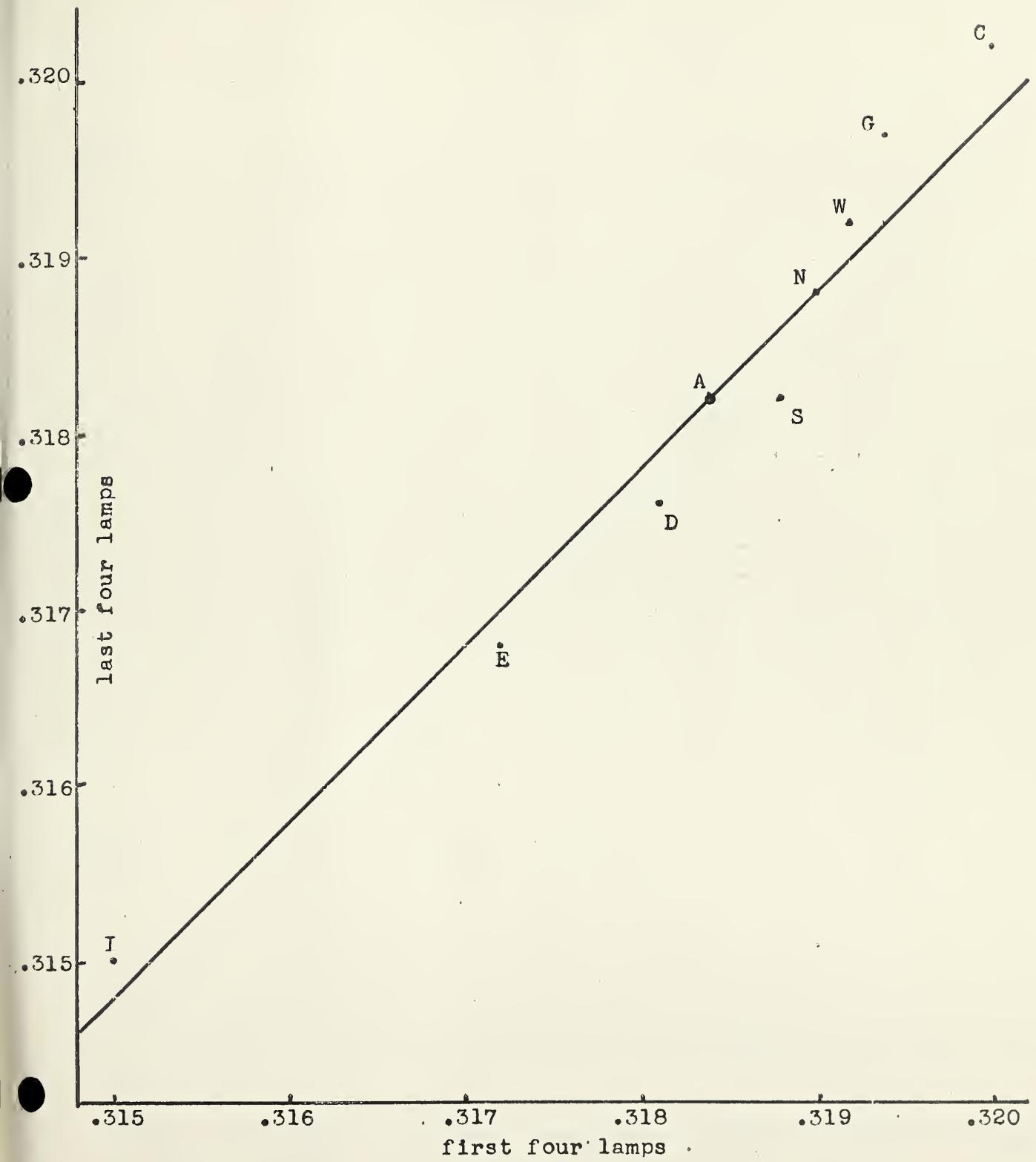
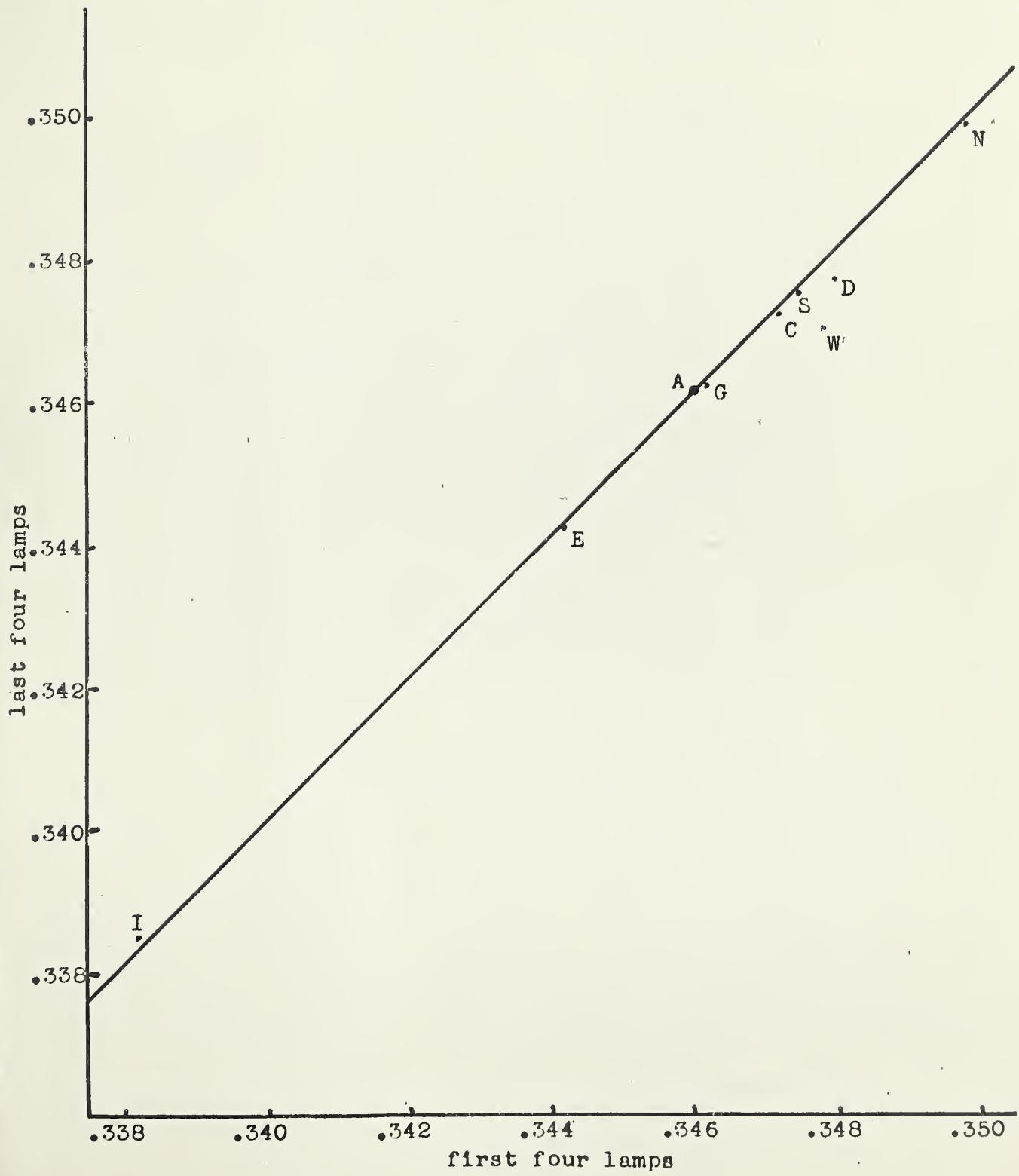




Figure 7  
y Coordinate





U.S. DEPARTMENT OF COMMERCE

Frederick H. Mueller, *Secretary*

NATIONAL BUREAU OF STANDARDS

A. V. Astin, *Director*



## THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colo., is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

### WASHINGTON, D.C.

**ELECTRICITY.** Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics.

**METROLOGY.** Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

**HEAT.** Temperature Physics. Heat Measurements. Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research. Equation of State. Statistical Physics. Molecular Spectroscopy.

**RADIATION PHYSICS.** X-Ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

**CHEMISTRY.** Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electro-deposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

**MECHANICS.** Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Combustion Controls.

**ORGANIC AND FIBROUS MATERIALS.** Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

**METALLURGY.** Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

**MINERAL PRODUCTS.** Engineering Ceramics. Glass. Refractories. Enamelled Metals. Constitution and Microstructure.

**BUILDING RESEARCH.** Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials.

**APPLIED MATHEMATICS.** Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

**DATA PROCESSING SYSTEMS.** Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Applications Engineering.

**ATOMIC PHYSICS.** Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics.

**INSTRUMENTATION.** Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Office of Weights and Measures.

### BOULDER, COLO.

**CRYOGENIC ENGINEERING.** Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

**IONOSPHERE RESEARCH AND PROPAGATION.** Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services.

**RADIO PROPAGATION ENGINEERING.** Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

**RADIO STANDARDS.** High frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

**RADIO SYSTEMS.** High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems. Space Telecommunications.

**UPPER ATMOSPHERE AND SPACE PHYSICS.** Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

